Diagnosis-Driven Prognosis for Decision Making, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

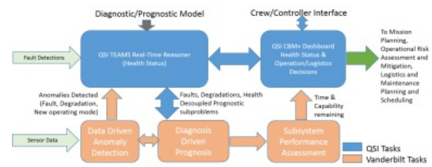
ABSTRACT

In Phase II, the QSI-Vanderbilt team seeks to develop a system-level diagnostics and prognostic process that incorporates a "sense and respond capability," which first uses error codes and discrete sensor values to correctly diagnose the system health including degradations and failures of sensors and components, and then invokes appropriate prognostics routines for the assessment of RUL and performance capability. The QSI-Vanderbilt team plans to emphasize advancement in the following five areas: (a) leverage extensive LADEE telemetry data to further enhance and develop online degradation profiles, performance analysis and remaining useful life (RUL) computation algorithms, (b) develop/implement degradation detection algorithms to compute time-to-alarm (TTA) and time-to-maintenance (TTM) predictions and correlate with alarm/maintenance events, (c) develop reusable library of models and tests, (d) verification and validation of the resulting solution, and (e) demonstrate the proposed solution on LADEE's and other spacecraft subsystems. Once fully developed, outcomes of this effort will lower the cost of developing prognostics and provide maximum critical system availability, smarter scheduling of maintenance, overall logistics support cost, and optimal match of assets to missions. The proposed offering will also provide a cost-effective and pragmatic solution to our commercial customers who want to reduce unscheduled downtime by practicing condition based maintenance, but cannot justify the cost of developing prognostic methods in the conventional way.

ANTICIPATED BENEFITS

To NASA funded missions:

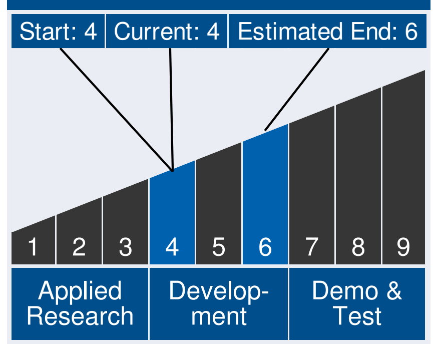
Potential NASA Commercial Applications: NASA is developing increasingly autonomous systems that can perform missions with a high degree of certainty with minimal human intervention. Examples of such mission include rovers operating in Mars,



Diagnosis-Driven Prognosis for Decision Making

Table of Contents

Technology Maturity



Management Team

Program Executives:
- Joseph Grant
- Laguduva Kubendran

Program Manager:
- Carlos Torrez

Continued on following page.

where the missions are extremely long, and therefore multiple components and subsystems will degrade and fail over the duration of the mission. However, due to the long communication delays between Mars and Earth, these systems cannot be monitored and diagnosed by mission control like any other near-earth mission. The proposed capability will be invaluable to NASA for such operations by (a) Predicting failures before they disrupt the mission, (b) Reducing false positives of such prediction with the proposed diagnosis-driven prognosis, and (c) identifying the remaining useful capability of the system. This will enable NASA to focus on the mission planning and recovery aspects, and manage the health of the system, rather than being blindsided by unexpected failures.

To the commercial space industry:

Potential Non-NASA Commercial Applications: The potential applications for DoD and Commercial users are even larger. This is because they are likely to operate multiple systems, a fleet of vehicles for example, that have the opportunity of periodic preemptive maintenance. To address these customers' needs, we will develop a decision-support module on top of the proposed capability here that will allow the customer to define his own business rules. Such business rules will help the customer answer questions like "if the system has a scheduled downtime window of 2 hours tomorrow, what pre-emptive repairs should I perform within that maintenance window so as to minimize the chance of unscheduled downtime (due to failure) in the next 10 days". For enterprise-wide logistic planning, this decision-making capability will also help optimize the cost of additional opportunistic maintenance versus the cost of additional downtime if such maintenance were not performed. The capability developed here is key to proving the business case for prognostics in commercial and military applications.

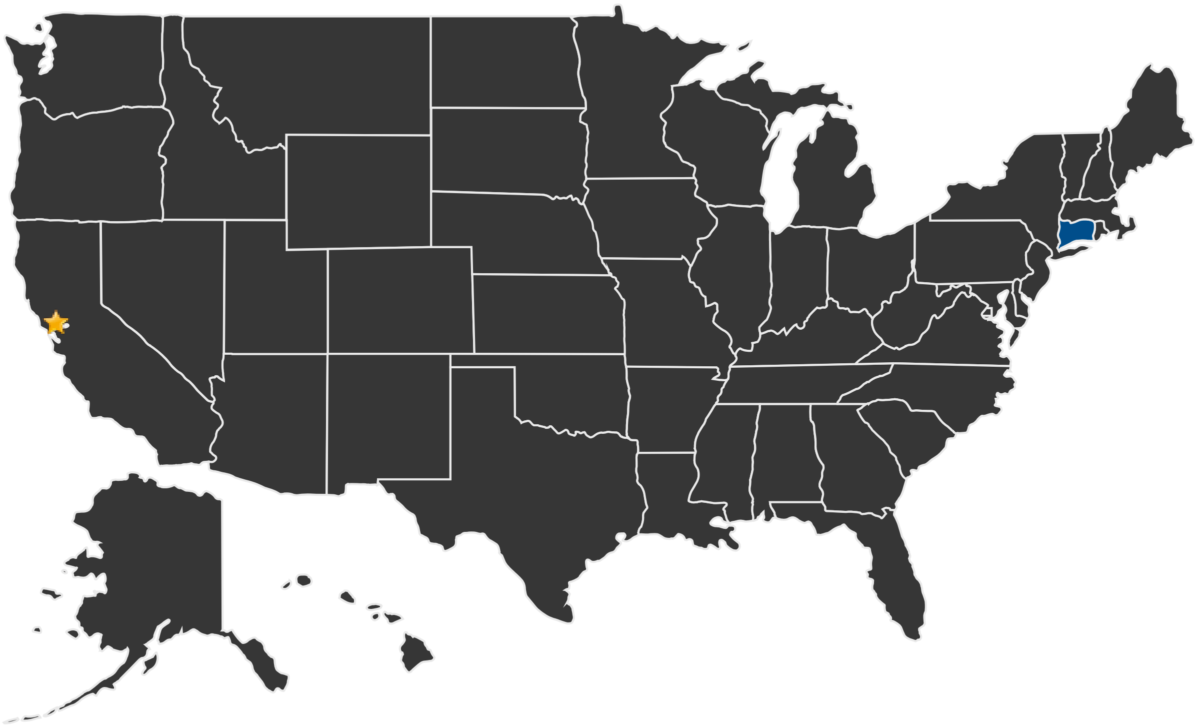
Management Team *(cont.)*

Principal Investigator:
- Somnath Deb

Technology Areas

Primary Technology Area:
Modeling, Simulation, Information Technology and Processing (TA 11)
└─ Information Processing (TA 11.4)
  └─ Intelligent Data Understanding (TA 11.4.2)
    └─ Event Detection and Intelligent Action Toolset (TA 11.4.2.2)

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Ames Research Center

Other Organizations Performing Work:

- Qualtech Systems, Inc. (East Hartford, CT)

PROJECT LIBRARY

Presentations

- Briefing Chart
    - (http://techport.nasa.gov:80/file/17893)

DETAILS FOR TECHNOLOGY 1

Technology Title

Diagnosis-Driven Prognosis for Decision Making